

Effect of Jigsaw-II Instructional Strategy on Performance and Retention of Geometrical Concept among Senior Secondary Students in Katsina State

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Abstract

This study investigates the Effectiveness of Jigsaw-II Instructional Strategy on Performance and Retention of Geometrical Concept among senior Secondary Students in Katsina State. A quasi-experimental design was adopted for the study. The population of the study consists of 77,117 senior secondary school class two (SS II) students. A sample size of 159 students were selected from the target population using a multistage sampling technique. Data were obtained using the Geometry Performance Test (GPT), which was validated and a reliability coefficient of 0.82 was obtained. The research questions were answered using mean and standard deviation, and hypotheses were tested using ANCOVA at 0.05 level of significance. The findings revealed that students taught geometry using jigsaw-II instructional strategy (JIS) significantly outperformed and retained the concept better than those taught using the lecture method (LM). Based on these findings, JIS was more effective in teaching geometry concept than LM and recommended that mathematics teachers should adopt the JIS to enhance students' engagement, performance, and retention in geometry and related topics.

Keywords: Jigsaw Strategy, Performance, Retention, Geometry

Introduction

Teaching strategies have a significant impact on students' academic performance and retention in the classroom, especially in subjects that call for both conceptual knowledge and real-world application. While retention refers to the long-term storage and retrieval of learnt data for future application, performance, as an indication of accomplishment, represents students' capacity to understand and apply concepts effectively. Since students frequently need to apply abstract ideas like mensuration to address real-world situations, these dependent variables are essential in mathematics education (Valderama & Oligo, 2021). However, there is also disagreement about how well teaching strategies work to achieve these goals, with conventional lecture-based techniques frequently falling short in terms of student engagement or fostering deeper comprehension (Armstead & Gragg, 2022).

The requirement for creative teaching tactics is shown by the connection between teaching strategies and students' academic performance. By actively engaging students in the learning process, effective teaching strategies not only improve retention but also make comprehension easier. Cooperative learning techniques, for instance, have been demonstrated to promote engagement, accountability, and interaction while promoting a better comprehension of challenging subjects (Khan, 2019). Because mensuration is abstract and depends on geometric concepts, it poses special difficulties as a crucial subject of mathematics. Research has shown that lack of use of teaching strategies that neglect the interactive and practical components of the topic are frequently associated with poor performance and retention in mensuration (Yakubu, 2016).

The Jigsaw-II strategy, a cooperative learning approach, has demonstrated potential for improving students' academic outcomes, particularly in challenging subject areas. This strategy engages students in collaborative activities where they learn specific material, teach it to peers, and collectively synthesize knowledge through group discussions and presentations (Aronson, 2023). The Jigsaw technique is particularly useful for complex topics like geometry in mathematics because of its organized stages, which include expert group discussions and knowledge sharing among group members. These phases enable deeper investigation of the material and close learning gaps (Gonzalez, 2015).

As a dependent variable, performance refers to students' ability to demonstrate their understanding of geometry through measurable academic outcomes such as test scores, problem-solving accuracy, and application of concepts in real-world scenarios. Another critical dependent variable is retention, which involves students' ability to store and recall mathematical knowledge, ensuring they can retrieve and apply it when needed. Effective memory of geometry concepts such as calculating geometric forms' areas, volumes, and perimeters is critical for laying the groundwork for advanced mathematical topics and real-world applications (Valderama & Oligo, 2021).

Qualities such as area, volume, and perimeter are studied and calculated in geometry, a basic field of mathematics. However, it is frequently viewed as abstract and challenging, which results in ongoing difficulties with students' performance and retention. Yakubu (2016) found that low performance in mensuration is mostly caused by a lack of understanding of fundamental geometrical concepts and an inability to apply them to problem-solving activities. Similar to this, Armstead and Gragg (2022) pointed out that students find it difficult to remember important concepts when traditional, lecture-based teaching techniques fail to appropriately handle the interactive and practical character of mensuration.

According to research, these difficulties may be lessened by using cooperative learning techniques like the Jigsaw IV approach. Cooperative learning strategies enhance performance by encouraging active involvement, group responsibility, and peer-to-peer teaching, according to studies like those by Khan (2019) and Gonzalez (2015). For example, Gonzalez (2015) showed that students taught using the Jigsaw technique recalled more knowledge than their peers exposed to standard teaching methods, while Khan (2019) highlighted that collaborative assignments improve conceptual comprehension. Additionally, Yakubu (2016) reported that students who were exposed to cooperative learning strategies outperformed their peers in mensuration tasks, demonstrating the efficacy of these approaches in tackling subject-specific difficulties.

The study's focus on Katsina State secondary school students is especially warranted given the region's ongoing difficulties with mathematics instruction. Studies have shown that traditional teaching approaches, a lack of interactive learning methodologies suited to the local educational environment, and a lack of instructional resources all contribute to Katsina State students' low performance in mensuration. For example, Yakubu (2016) found that low performance in mensuration is mostly caused by a lack of understanding of fundamental geometrical concepts. Similarly, a research by Kankia (2011) showed that students find it difficult to remember important

ideas since traditional, lecture-based teaching approaches do not sufficiently handle the interactive and practical aspect of mathematics. Therefore, carrying out the study in this setting guarantees that the results are relevant to similar places with comparable educational issues and provide insightful information about how to improve mathematics education.

Statement of the Research Problem

Mathematics failure is still a major global problem, but especially in Nigeria, and Katsina State in particular. The WAEC Examiners' Reports (2019, 2021) pointed out that students showed deficiencies in resolving geometry-related issues, highlighting geometry as one of the troublesome mathematical concepts. Additionally, the 2024 WASSCE report showed that applicants' performance in English language and mathematics had decreased by 7.69% from 2023 (Omisakin, 2024). Accordingly, Wasagu and Kabir (2022), Ibrahim et al. (2023), and Dauda et al. (2024) identified a number of factors that contribute to this low performance, including inadequate laboratories and instructional materials, students' lack of background, and teachers' improper implementation of the curriculum. These problems are made worse by the widespread adoption of lecture teaching method, which do not actively involve students in the learning process. Furthermore, students find it difficult to use their mathematical understanding to resolve practical issues, especially those involving geometry. To address these issues, appropriate teaching strategies for geometrical concepts must be developed. This study aims to investigate the effectiveness of the Jigsaw-II instructional strategy in enhancing students' performance and retention of geometry in Katsina State, Nigeria.

Objectives of the Study

The following are the objectives of the study:

1. to examine the effect of jigsaw-II instructional strategy on performance in geometry among senior secondary students in Katsina State;
2. to investigate the effect of jigsaw-II instructional strategy on retention of geometry among senior secondary students in Katsina State.

Research Questions

The following questions were drafted to guide the study:

1. What is the difference between the mean performance scores of students taught geometry using jigsaw-II instructional strategy and those exposed to lecture method?
2. What is the difference between the mean retention scores of students taught geometry using jigsaw-II instructional strategy and those exposed to lecture method?

Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance:

Ho1: There is no significant difference between the mean performance scores of students taught geometry using jigsaw-II instructional strategy and those exposed to lecture method.

Ho2: There is no significant difference between the mean retention scores of students taught geometry using jigsaw-II instructional strategy and those exposed to lecture method.

Methodology

The study adopted Quasi-experimental research design in order to establish a cause-and-effect relationship between the variables. The population of the study consists of 77,117 senior secondary school class two (SS II) students. A sample size of 159 students were selected from the target population using a multistage sampling technique.

The instrument used for the study data collection was Geometry Performance Test (GPT) which was validated by three experts in mathematics education with a reliability coefficient of 0.82 tested using Cronbach's Alpha. It was used to test the students' performance and retention abilities on geometry which was administered three times as pretest, posttest and post-posttest. All the research questions were answered using mean and standard deviation, while the hypotheses were tested using ANCOVA at 0.05 significance level.

Results

Research Question 1

What is the difference between the mean performance scores of students taught geometry using jigsaw-II instructional strategy and those exposed to lecture method?

To answer the research question 1, MPT marks of students taught geometry using jigsaw-II instructional strategy and those taught using Lecture method were subjected to descriptive statistics of mean and standard deviation in table 1

Table 1

Means and Standard Deviations Performance Scores of JIS and LM

Strategy	<i>N</i>	Mean	<i>SD</i>	Mean Diff.
JIS	75	52.50	12.25	10.71
LM	84	41.79	10.81	

From table 1 the mean and standard deviation performance scores of students taught geometry using JIS ($M = 52.50$, $SD = 12.25$) was greater than that of those taught using LM ($M = 41.79$, $SD = 10.81$) with difference of 10.71 mean score. To investigate whether the difference is significant or not, null hypothesis one was tested and the result presented in Table 3.

Research Question 2

What is the difference between the mean retention scores of students taught geometry using jigsaw-II instructional strategy and those exposed to lecture method?

Table 2

Means and Standard Deviations Retention Scores of JIS and LM

Strategy	<i>N</i>	Mean	<i>SD</i>	Mean Diff.
JIS	75	56.12	13.71	

				10.77
LM	84	45.35	12.82	

In table 2 the mean and standard deviation retention scores of students taught mensuration by the JIS ($M = 56.12$, $SD = 13.71$) was higher than that of LM ($M = 45.35$, $SD = 12.82$) with difference of 10.77 mean score. To investigate whether the difference is significant or not, null hypothesis two was tested and the result presented in Table 4.

Hypothesis 1

There is no significant difference between the mean performance scores of students taught geometry using jigsaw-II instructional strategy and those exposed to lecture method.

The hypothesis was tested using ANCOVA in the table 3.

Table 3

Analysis of Covariance on Mean Performance Scores of JIS and LM

Source	Type III Sum of				
	Squares	df	Mean Square	F	Sig.
Corrected Model	4200.183 ^a	2	2100.091	14.776	.000
Intercept	44419.361	1	44419.361	312.524	.000
Pretest	537.684	1	537.684	3.783	.054
Treatment	3520.664	1	3520.664	24.771	.000
Error	22172.459	156	142.131		
Total	367525.000	159			
Corrected Total	26372.642	158			

Note. R Squared = .159 (Adjusted R Squared = .148)

The ANCOVA result in table 3 showed that there was significant difference in the mean performance scores of the students taught geometry using JIS and those taught through LM, $F(1, 156) = 24.77$, $p < .05$. Hence, the null hypothesis was rejected.

Hypothesis 2

There is no significant difference between the mean retention scores of students taught geometry using jigsaw-II instructional strategy and those exposed to lecture method.

The hypothesis was tested using ANCOVA in the table 4.

Table 4

Analysis of Covariance Result on mean Retention Scores of JIS and LM

Source	Type III Sum of				
	Squares	df	Mean Square	F	Sig.
Corrected Model	16469.893 ^a	2	8234.947	59.375	.000

Intercept	3212.490	1	3212.490	23.163	.000
Posttest	8007.395	1	8007.395	57.735	.000
Treatment	2705.919	1	2705.919	19.510	.000
Error	21636.081	156	138.693		
Total	365050.000	159			
Corrected Total	38105.975	158			

Note. *R Squared* = .432 (Adjusted *R Squared* = .425)

Table 4 revealed that there was significant difference between the mean retention scores of the students taught geometry using JIS and those taught using LM, $F(1, 156) = 19.51, p < .05$. Hence, the null hypothesis was rejected.

Discussion of findings

Tables 1 and 3 showed that there was significant difference in the mean performance of students taught geometry using jigsaw-II instructional strategy and those taught through LM and the difference is in favour of those taught using Jigsaw instructional strategy. This agreed with the findings of Yakubu (2016) on “Impacts of Jigsaw II Co-operative learning strategy on academic performance and retention in mensuration among senior secondary school students in Kano State”. The findings showed that the mean performance of students taught using jigsaw II co-operative learning strategy is higher than that of lecture method. Other corresponded research finding include that of Abdullahi and Salisu (2017) whose finding showed that experimental group had higher mean score than that of control group, and suggested that cooperative instruction was the best approach to enhance students learning of Arabic language. This could be attributed to the fact that in cooperative learning as in the case of jigsaw strategy, students were actively involved in the learning process. Therefore, in this study jigsaw-II instructional strategy improves the students’ performance in geometry.

Tables 2 and 4 revealed that the students’ mean retention scores of the two groups were different, the students taught geometry using jigsaw-II instructional strategy retained significantly higher than those taught using lecture method. The findings are in line with that of Jamilu et al (2022) whose finding revealed that students taught with Jigsaw IV strategy retained higher in geometry than those taught using lecture method. Also, the findings of Nwankwo and Okigbo (2021) whose revealed that the students taught chemistry using jigsaw strategy retained significantly higher than those taught using traditional method. According to Valderama and Oligo (2021), learners’ retention is increasing due to use of good and effective instructional method by the teachers. Thus, treating students through jigsaw-II instructional strategy could increase their retention abilities on geometry.

Conclusion

Based on the study findings, it could be concluded that jigsaw-II instructional strategy was better and more effective in teaching geometry and could enhanced the students’ performance and retention ability more than the lecture method commonly used in the study area. Since, the students

were actively involved into the lesson activities of the strategy. Thus, the strategy could be used in place of lecture method for better achievement.

Recommendations

On the basis of the findings and conclusion of the study, the following recommendations were made:

1. Secondary school mathematics teachers should be encouraged in using jigsaw-II instructional strategy in teaching geometry and other related concepts.
2. Jigsaw-II Strategy should be incorporated into the curriculum for effective teaching of geometry concept and other aspects of Geometry concept in all Senior Secondary Schools in Katsina State.
3. Professional bodies such as Mathematics Association of Nigeria (MAN), Science Teachers Association of Nigeria (STAN) and Nigerian Educational and Research Development Council (NERDC) should encourage the use of the alternative strategy in all educational levels especially at junior and senior secondary schools.
4. Seminars, workshops and conferences should be organized for mathematics teachers on how to adopt strategy in teaching their students for effective and better achievement of the designed objectives.

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